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ABSTRACT

A study examined causal reasoning in the context of story recall and story production in young children. Subjects, 20 kindergarten and 20 first grade students matched according to I.Q. scores, parental demographics, and preschool experience, were read stories and asked to recall them and given the setting for a story and asked to complete it. The stories were analyzed for the nature of causal reasoning in them. Results indicated that no significant differences existed in the story recall of kindergarten and first grade students, but the structure of their recall shifts to the causally more important by the end of first grade. Results also indicated no evidence for change in causal reasoning with either group's story production task. (One table and three figures of data are included; and 11 references are attached.) (RS)

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Development of Causal Reasoning in Story Recall and Production

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Development of Causal Reasoning in Story Recall and Production

This study examined causal reasoning in the context of story recall and production. Stories make sense because they invariably contain causal and logical connections that relate the different pieces of information that is presented in the story. Simple procedures for analyzing story information based on what purpose the information serves in the story have been developed (Mandler & Johnson, 1977; Stein & Glenn, 1978) and the relationships that connect story information have been elaborated (Trabasso, Secco, & van den Broek, 1984; Trabasso & Sperry, 1985). Thus, stories, with their regular causal structure, represent an ideal context in which to study causal reasoning and how formal schooling might influence it.

We investigated three aspects of story recall that may or may not change with age and/or early school experiences. Ranging from global to very specific aspects of story memory and comprehension, we examined overall amount of story recall, recall of specific information and events, and recall of the story events as a function of causal relations within the story. We used a similar approach to investigate story telling skill, examining amount of information provided, what function the information served in the story, and degree of connectedness to the rest of the story.

Expanding on the picture memory findings just reported by Smith (1989), we might expect quantitative differences in story recall between the kindergarten and grade one children, most likely at the postest. Growth in short-term memory strategies through the grade one experience may transfer to the story memory task, increasing the young children's ability to recall more information about even the simple stories that we read to them.

A more interesting question, however, is whether there are any differences in recall that can be attributed to changes in the ability to deal with the logical structure of stories. Well written, cohesive stories tend to conform to a common structure. The structure of stories consists of different types of logically and causally related information and events

indicating how a protagonist attempts to solve a problem or achieve some goal. Analysis of recall by children in grades one and two suggests that they may be sensitive to the logical structure of stories (Mandler & Johnson, 1977; Stein & Glenn, 1978; Trabasso, Secco, & van den Broek, 1984). Certain types of story information is more likely to be recalled (e.g. setting, initiating event, attempt, and consequence) as is more related information.

In order to use logical structure to guide story comprehension and memory, children must be able to understand the functions of the different parts of a story and how the information is interrelated. Although children as young as four years of age produce speech statements that seem to imply an understanding of causal connectivity (reviewed in Salgo, 1988), Piaget (1960) argued that children's causal and logical thinking does not develop until between five and eight years of age. If so, then children are becoming able to comprehend and use the logical structure of stories around the time that they begin formal schooling. Thus, it becomes reasonable to investigate whether the schooling experience has any impact on the young child's ability to comprehend and remember stories according to their logical structure.

Similar questions may be asked about children's story production abilities. Making up and telling an original story is somewhat more complex than retelling a remembered story. At the very least, new information is presented while telling the story and the information must be logically organized in order to be comprehendible to the listener. Children amass a good deal of experience with creating narrative situations in make-believe play. Thus, they shouldn't find the story production task too novel or difficult. Because story telling is a relatively common childhood pastime, we expected no overall differences in amount of information provided in a story production task.

Although the length of the story is likely to remain the same, the structure of young children's stories may change as a function of increases in causal reasoning. Stein and her colleagues (Stein & Policastro, 1984; Stein, 1988; Stein & Kilgor, 1988) have found

evidence that young children have a much broader story concept than older children and that preschoolers include information from fewer story categories than older children. In addition, Salgo (1988) found both qualitative and quantitative differences between preschoolers and grade two children in terms of causal connectivity in story production.

Method

Subjects

A subset of 20 kindergarten and 20 young grade one children were selected from the larger group. There were an equal number of males and females in each group. The groups did not differ on I.Q., parental demographics, or preschool experience.

Materials

Four short, single-episode stories were adapted from Goldman and Varnhagen (1986) for use with both tasks. Table 1 contains an example. The stories were parsed into statements, each consisting of a predicate proposition and all associated modifiers -- a statement is most easily conceptualized as a simple sentence. The story information and events were analyzed according to story category using Stein and Glenn's (1979) terminology. The same organization of story categories can be described for each story: Two statements each conveyed story information classified as setting, initiating event, attempt, consequence, and reaction; one statement was classified as an internal response and one as the goal of the story.

A causal analysis of the stories was also performed using the counterfactual reasoning framework developed by Trabasso and his colleagues (Trabasso, Secco, & van den Broek, 1984; Trabasso & Sperry, 1985). From this analysis, each statement was classified according to how many causal connections it had with other statements (one, two, three, and four or more causal connections) and whether or not it was located along the causal chain of story events. The stories differed only slightly in terms of causal connectivity. Ranges across the four stories were: 1 - 2 statements in each text had one

causal connection, 4 - 5 statements had two causal connections, 3 - 5 had three, and 2 statements in each text had four or more causal connections with the rest of the text. As with the Stein and Glenn (1979) stories reanalyzed by Trabasso, Secco, and van den Broek (1984) statements classified as initiating event, attempt, or consequence information generally had a greater number of causal connections.

Insert Table 1 About Here

Procedure

In the story recall task, the experimenter read one of the stories and then asked the child to recall it. The task was presented as a game of retelling stories and the experimenter emphasized remembering what happened in the story and not the exact words. If the child hesitated during recall, the experimenter prompted with "You're doing a super job of telling me the story. Can you remember anything else from the story?"

The experimenter read the child setting and initiating event (stem) information from another story and then asked the child to complete the story in the story production task. If the child hesitated, the experimenter prompted with "This is a really neat story. Can you tell me some more?" When the child indicated that the story was complete, the experimenter read the story back to the child, including the stem information, and asked whether the child wanted to add to or change the story in any way.

Testing was conducted both at the beginning (pretest) and end (postest) of the school year. Story recall and production were introduced in a practise task consisting of recalling a very short story and completing another story given setting through attempt information. The story recall task was presented first followed by the generation task. Order of presentation of the four stories (either as whole stories for the recall task or stem information for the production task) was counterbalanced across subjects and testing times.

Results and Discussion

Story Recall

The children's oral story recall protocols were scored for gist recall of presented story statements, plausible inferences added to the recall of presented information, and distortions of presented statements. The children included very few inferences in their recalls and seldom distorted presented information; as a result, we haven't analyzed these additions to recall. Gist recall of presented story statements was examined in three ways: Overall recall was analyzed to investigate general memory changes, proportion of statements recalled from each of the six different story categories was analyzed in order to investigate changes in sensitivity to story information, and recall for statements differing in terms of number of causal relations was analyzed to investigate changes in logical reasoning.

There were no overall differences recall. Both groups of children recalled an average of approximately 30% of the presented statements at pretest and at postest.

There were also no overall effects of group or testing time obtained for patterns of recall across the different story categories. These patterns are shown in Figure 1. Both groups of children at both testing times averaged greater proportions of recall for information in setting, initiating event, attempt, and consequence categories. The kindergarten group included very few goal statements in their recall at the postest, but the differences are nonsignificant. The other, more minor, variations in the patterns of recall are also nonsignificant.

Insert Figure 1 About Here

Analysis of recall for statements differing in terms of their number of causal connections to the rest of the text showed some very interesting changes. Proportion recall of statements having one, two, three, and four or more causal connections is shown in Figure 2 for the two groups at pretest and at postest. We would have liked to compare recall for statements located on the causal chain versus those off the causal chain but, in our stories, the variable of on/off the causal chain was confounded with number of causal connections: Those statements that were on the causal chain had two or more causal connections with the rest of the story whereas statements off the causal chain had only one causal connection. Even given the confound, however, it does seem that both groups are sensitive to causal chain membership; average recall for statements off the causal chain (.13) is much lower than for statements on the causal chain (.34).

Insert Figure 2 About Here

Analysis of recall for statements on the causal chain showed that the pattern for grade one children at postest differs from the patterns for kindergarten children and for the grade one children at pretest. At pretest, the patterns of recall for statements with two, three, and four or more causal connections, shows a quadratic trend which is significant for the kindergarten children, $F(1,19) = 5.60$, $p = .03$, and marginal for the grade one children, $F(1,19) = 3.69$, $p = .07$. At postest, the kindergarten children show a flat, zero trend pattern of recall as a function of number of causal connections. The grade one children, on the other hand, show a marginally significant linearly increasing trend, $F(1,19) = 4.23$, $p = .05$, corresponding to adult patterns (cf. Trabasso, Secco, & van den Broek, 1984). Thus, the grade one children change from an inconsistent, immature pattern of recall at pretest to a more mature postest pattern that suggests sensitivity in recall to the causal connections among the story statements.

Story Production

The children's oral story production protocols were parsed into statements added to the stem information and scored for number of statements produced, type of information represented by each statement, overall structural complexity of the production, and number of causal connections of each statement with other statements.

Considering first the overall amount of information produced, there were no group or time of testing differences in number of statements produced. The children produced an average of 3.11 statements (s = 2.27 statements); although a few children produced extremely lengthy stories, most (90%) produced 5 or fewer statements.

Analyses of the type of information produced, causal connectivity, and the resulting structural quality of the story also revealed no differences as a result of schooling or testing time. We used Salgo's (1988) guidelines for scoring the type of information that was represented by each statement: Statements from goal-based productions were scored according to whether they provided setting, initiating event, internal response, goal, attempt, consequence, or reaction information. Statements from goal-based productions that did not relate to the goal structure of the story and statements from non-goal-based productions were scored as to whether they conveyed state, event, or result (of some event) information. We scored causal connections among the statements in each production protocol according to counterfactual reasoning (Trabasso, Secco, & van den Broek, 1984; Trabasso & Sperry, 1985). We also scored non-causal connections, ie., those that do not satisfy counterfactual reasoning but may be temporally or associatively based, between the statements. These non-causal relations were generally involved temporal contiguity between two statements. Finally, we based our scoring of the structural quality of the production on Stein's (1988; Stein & Policastro, 1984) taxonomy of structural complexity. The decision tree and a brief description of each of the categories is shown in Figure 3.

Insert Figure 3 About Here

The particular type of information a given statement provides about the story, its connectivity to other statements, and the overall structural quality of the story are highly inter-dependent. Thus we simultaneously scored all three aspects of the productions. For example, semantically identical events and results could be classified as attempts and consequences if causally related to an implicit or explicit goal. Consider the following production, based on the Thunder stem: "Thunder ate the carrots." The information in the single produced statement is scored as a result that was enabled by the event of seeing the carrots, and the entire production is scored as a reactive sequence. If, however, an explicit or implied goal is produced, as in "Thunder was hungry. He went and he ate the carrots.", the same information about eating is scored as consequence information -- causally resulting from going to the carrots because of the implied goal of wanting to eat the carrots to satisfy his hunger -- and the entire production is scored as a simple episode.

The structurally most simple production that we obtained consisted of at least one statement temporally related to some stem statement and was classified as an action sequence. There were no instances of Stein's least complex type of production, no structure, and there was only one instance of a descriptive sequence. The most common structure produced was a reactive sequence, in which the child minimally produced a causally related result to some stem event. Across groups and testing times, 51 (64%) of the productions were classified as reactive sequences. These reactive sequences were an average of 2.5 statements in length (s = 1.6 statements). A typical reactive sequence consisted of two results of some stem event information, such as the following in response to the stem event that Thunder saw a bag of carrots: "then he ate them and then he was full." Additional state or event information was also likely to be produced. There were no

differences in number of statements, type of information (state, event, or result), or number of causal connections (zero, one, or two or more) produced in reactive sequences as a function of group or testing time.

Twenty (25%) of the productions were goal-based: Generally this type of production consisted of a simple, no obstacle episode with no ending. These stories (11 -- 55% of the goal-based stories) often included only attempt and consequence information resulting from an implied goal, such as "The horse escaped and came and ate the carrots.", consisting of two associated attempts to obtain an implied goal of eating the carrots followed by goal attainment. The major difference between these goal-based stories and the more common, non-goal based reactive sequence productions is the inclusion of some action taken by the protagonist that results in some outcome and therefore allows for goal inference. These simple, no ending stories, and other, more complex obstacle and multiple episode stories, were evenly distributed across groups and testing times.

General Discussion

The story recall findings have fascinating implications for the effects of formal schooling on causal reasoning and memory. The kindergarten and grade one children do not differ in terms of absolute memory for the simple stories we read to them, but the structure of their recall does begin to change across grade one. Although both groups of children remember, for example, a certain amount of attempt or consequence information, at the time of the postest, the grade one children recall the causally more important attempt and consequent information.

On the other hand, we don't see evidence for changes in causal reasoning with the story production task. In fact, both groups of children at both testing times produce stories that are a bit shorter and a bit less complex than Salgo's (1988) preschool children. This may have been because our task was somewhat constrained; our children were required to complete a story already begun for them whereas Salgo's children were only provided with

a character about whom they produced any kind of story. Even so, Salgo found large increases in causal complexity from preschool to grade two; we are about to give our subjects a second postest (the kindergarten children are now in grade one and the grade one children are in grade two) and are anxious to investigate what we hope are some interesting changes in story production, related either to general changes in age or due to specific schooling experiences.

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Table 1.

Example story.

Story Category	Number of Causal Connections	Story Statements
Setting	2	Once upon a time there was a horse named Thunder
Setting	2	who lived in a big barn.
Initiating Event	3	One morning Thunder looked out the barn window
Initiating Event	3	and saw a bag of carrots.
Internal Response	2	Thunder was very excited
Goal	4+	and wanted to eat the carrots.
Attempt	2	Thunder kicked down the barn door
Attempt	3	and ripped open the plastic bag.
Consequence	4+	Thunder ate all the carrots
Consequence	1	and checked the ground for crumbs.
Reaction	2	Thunder felt very good
Reaction	1	and quickly trotted into the barn.

Other themes: Sally story: Sally knocks a bird's nest out of a tree and makes a new one

Jimmy story: Jimmy wants a dog and buys one

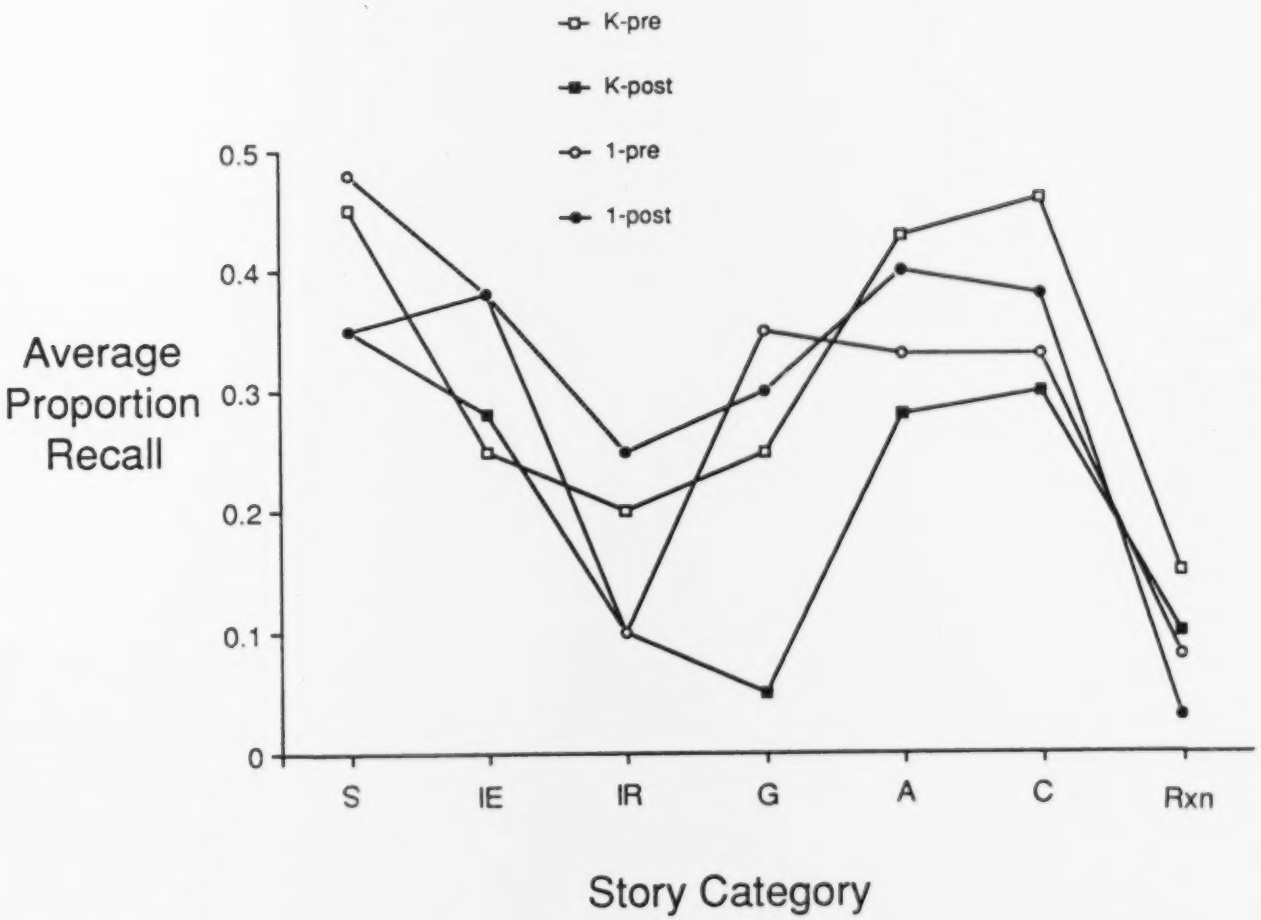
Beaver story: A beaver finds a hole in his dam and fixes it

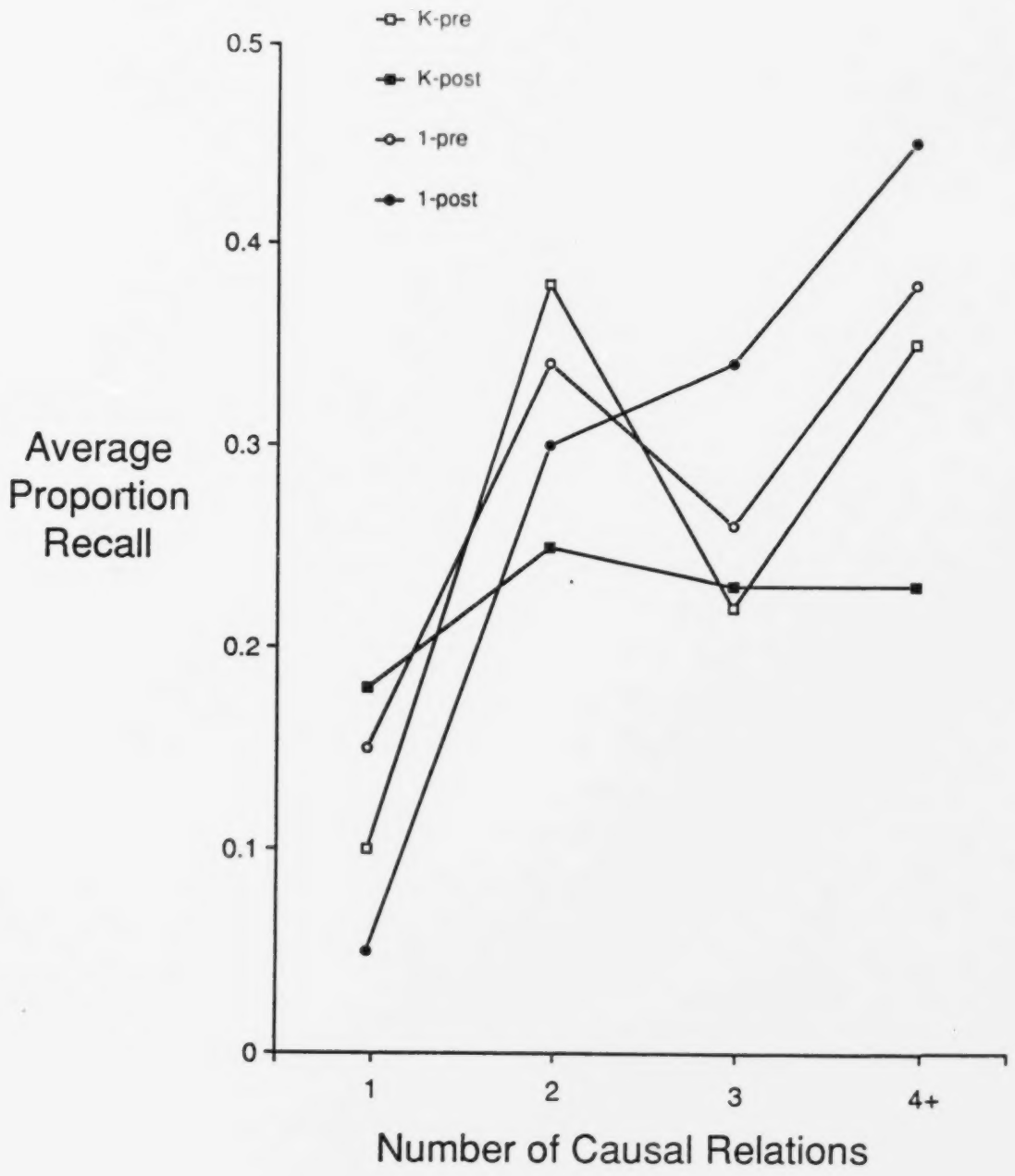
Figure Captions

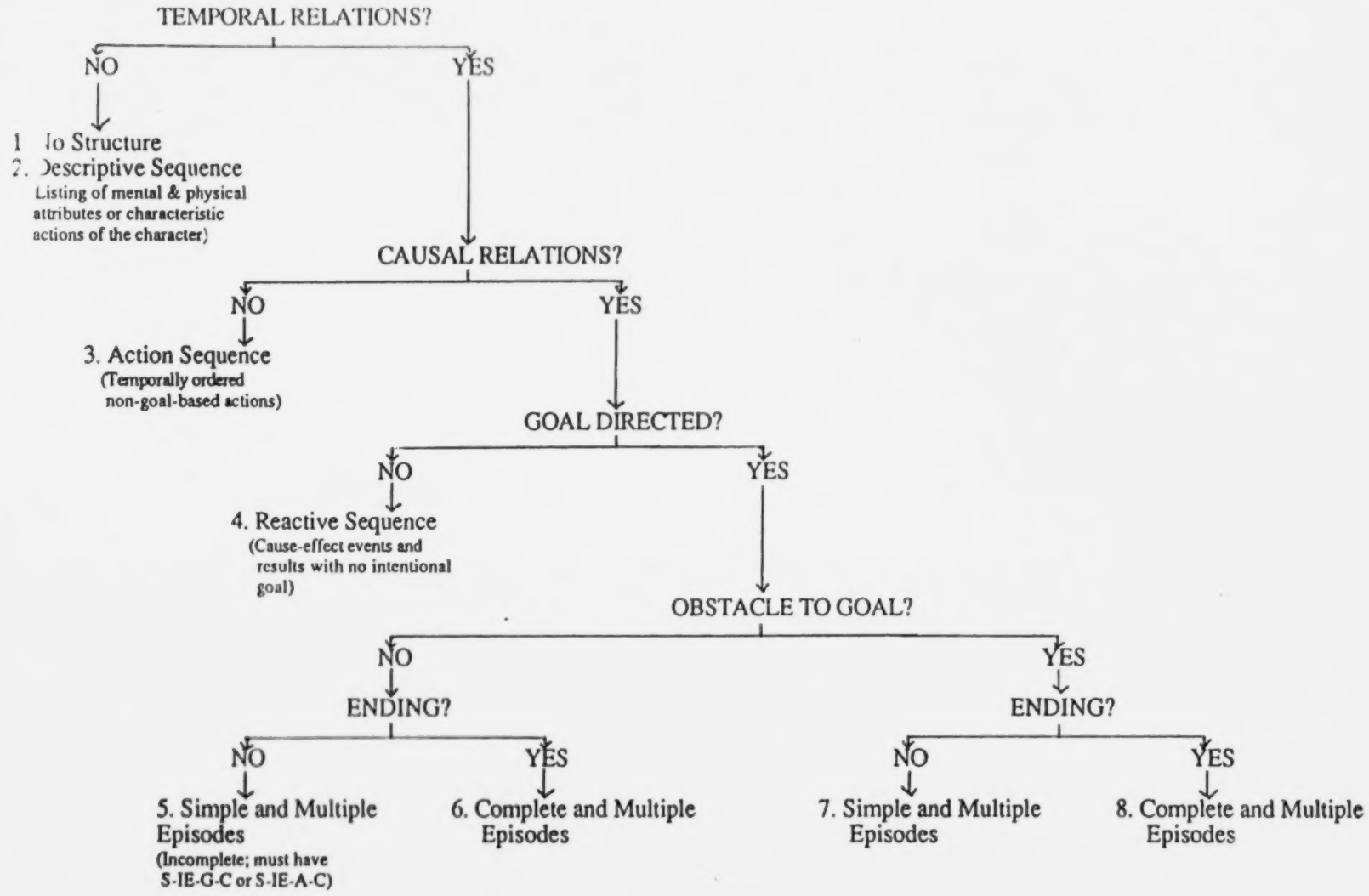
Figure 1. Story category recall.

Figure 2. Recall as a function of number of causal connections.

Figure 3. Structural quality decision tree.


K-pre
K-post
1-pre
1-post
Average Proportion Recall
0.5
0.4
0.3
0.2
0.1
0
S
IE
IR
G
A
C
Rxn
Story Category


K-pre
K-post
1-pre
1-post
0.5
0.4
0.3
0.2
0.1
0
Average Proportion Recall
1
2
3
4+
Number of Causal Relations


TEMPORAL RELATIONS?
NO
YES
1 lo Structure
2. Descriptive Sequence
Listing of mental & physical attributes or characteristic actions of the character)
CAUSAL RELATIONS?
NO
YES
3. Action Sequence
(Temporally ordered non-goal-based actions)
GOAL DIRECTED?
NO
YES
4. Reactive Sequence
(Cause-effect events and results with no intentional goal)
OBSTACLE TO GOAL?
NO
YES
ENDING?
ENDING?
NO
YES
NO
YES
5. Simple and Multiple Episodes
(Incomplete; must have S-IE-G-C or S-IE-A-C)
6. Complete and Multiple Episodes
7. Simple and Multiple Episodes
8. Complete and Multiple Episodes